Kachina Village Improvement District

Drinking Water System Efficiency Audit

Scope of Work (SOW)

1.0 General

The purpose of the Kachina Village Improvement District (KVID) SOW is two-fold: 1) to assist in verifying the location of utilities and validity of as built drawings and, 2) to identify operational and energy deficiencies in the system.

To assist with the first part of the study, KVID mapped and loaded the physical location of all infrastructure and appurtenances into ArcMap (ESRI) GIS. The data collection was completed utilizing as-built drawings, maintenance records, pulling institutional knowledge from our long-term underground contractor and employees, and using other available data.

For the second part of the study, KVID has captured the classical energy audit data of all the rotating equipment, heaters and other energy consumer devices in its inventory. Equipment nameplate and manufacturer's data has been documented including the make, model, and power requirements (volts, current, horsepower and number of phase connections). Actual data including the equipment location, measured voltage, measured current, power factor and harmonic content has also been recorded. System demand curve data was captured by the KVID's SCADA system and compared against the original design data to ensure all rotating equipment is operating at or near the best efficiency points (BEP). In addition KVID conducted a full Government Accounting Standards Board (GASB) title 34 audit in 2006 and updates this inventory each year.

At this point KVID is believed to have a good understanding of the system and its efficiency, but desires to ensure the accuracy of the collected data and potential issues that may still be lurking within the system. The intent of this work is to identify previously undetected issues, select opportunities and undertake projects to complement KVID's conservation effort and improve the energy efficiency, processes, and procedures within the system.

This is to be accomplished by conducting this study, identifying undetected efficiency losses, constructing a hydraulic model, and comparing to the actual recorded SCADA and billing data against the model data. In addition the contractor will examine the water system to identify deficiencies and discrepancies between the model and actual data. KVID intends to use the final product to plan, schedule, budget, and implement capital improvement projects to mitigate outlined deficiencies.

2.0 Collection and Evaluation of Baseline Data

The contractor shall evaluate system maps, equipment data and energy usage data provided by KVID. This will establish a baseline to determine how the utility's energy management and consumption changes over time due to seasonal and other variations. The collection and evaluation of baseline data from the Kachina Village Improvement District shall include, but not be limited to:

System Maps that include:

- All water sources and Entry Points into the Distribution System (EPDS)
- Water storage facilities with their respective elevations
- Pressure boosting facilities
- Pressure Reducing Valves (PRVs)
- Pressure zones and isolation valves
- Air and vacuum release valves (ARVs)

Energy Usage:

- Monthly data for one to three years of consumption
- Energy base costs for meters at each facility
- Monthly unit costs for electricity (In kWh)

Equipment:

- Pump data
    - Head curves for the pumps,
    - System demand curves for all pressure zones
    - Motor data,
    - Operational hours, controls, start – stop cycles, runtime hours,
    - Measured pump flow and original theoretical flow,
    - Total dynamic head flow,
    - Discharge pressures,
    - Water level over the pump or suction pressure,
    - Power analysis utilizing KVID provided power analyzer to include three phase amperage, voltages, power factor, and harmonic content analysis,
    - Pump rotational speed,
    - Location of potential air lock construction.

- Pressure Relief Valves (PRVs)
    - Physical properties (size, location, etc.)

- Historical annual usage time
- Characterization of flow
- Inlet, outlet, and differential pressure
- Feasibility of on-site consumption of the power generated
- Proximity to electric Kachina Village Improvement District and APS infrastructure
- Potential water quality concerns

- Provide water modeling, testing efficiency of pump stations, and determine additional information to refine the model.
- Provide fire flow tests, confirming main sizes and other items that may be required to finish the water model and pump station concerns.
- Complete water model and pump station-modeling work, and develop final reports to identify energy efficiency work needed.

KVID Contribution:

- Data extraction, transformation and loading (ETL) to be accomplished by KVID includes:
  - Power analyzer graphic information,
  - Current phase balance calculations, and
  - System harmonics.

3.0 Field Investigation

A field investigation must be conducted by the contractor to obtain information for an equipment inventory, discuss process operations with the individuals responsible for day to day operation, discuss the impacts of specific energy conservation ideas, and identify the energy profiles of individual system components.

At a minimum, the site visit(s) should include the following:

- Verification of equipment nameplate data
- Performing equipment efficiency tests on large equipment.
  - This may include pressure, flow and electrical measurements (plant electrician will need to be available to assist).
- Installation of meters and data loggers or other instrumentation on selected equipment, as needed, to develop equipment use profiles.
- Interviews of the facility manager, operators and maintenance staff regarding:
  - Facility operation and historical energy saving procedures
  - Equipment maintenance problems

- Operational problems and requirements
- Equipment reliability
- Projected equipment needs
- Use schedules for specific equipment
- Review of Facility improvements

- Analysis of SCADA data for booster stations, wells, and distribution system.

4.0 Analysis of Data

Data collected during the assessment needs to be processed and analyzed. Computer energy models must be built to closely match field observations and a baseline against the potential energy savings from the proposed energy saving controls. The resulting data will be used to calculate the implementation cost, energy savings, and simple payback/lifecycle costs where applicable for each item being investigated.

Evaluation will include four categories of cost saving projects.

1. Operational Measures will include improvements that can be done at minimal cost. For example provide employee training on proper equipment use and operation.

2. Energy Conservation Measures will include energy saving projects, with a minimal return on investments.

3. Energy Supply Measures will include projects for alternative energy sources or utility rate schedule adjustments.

4. Alternative Energy Supply Measures will include diversified energy sources.

5.0 Final Report of Findings – Decision Matrix

A Technical Detailed Evaluation/Assessment should not be limited to, but including the following:

a. List of the energy deficiencies, needs, and conservation measures proposed for each facility.

b. Table that list cost to accomplish, guaranteed cost savings, installed project cost, and guaranteed simple payback.

c. Discussion on each energy deficiency, need or conservation measure that includes an equipment and technical description, detailed information about the energy savings for each category, the cost to implement, associated costs for equipment to be provided, O&M impacts, design criteria, and other considerations.

d. Cost proposal for the entire project. As a minimum the cost proposal will provide the total cost to implement all recommendations, including design, project management, labor, and material.

e. 10-year cash flow analysis that as a minimum includes energy savings, O&M savings,

annual financial cost, and any positive cash flow to Kachina Village Improvement District.

f. Proposed Implementation Strategy that as a minimum includes a milestone schedule, Operation and Maintenance plan, and training plan.

g. Proposed use of real time metering or any other method of monitoring for measurement and verification. (where applicable within the report)

h. Schedule milestones, including equipment servicing and preventative maintenance as well as operating manual type information where considered applicable.

i. Calculation spreadsheets detailing energy savings used in developing the prioritized list.

6.0 WIFA Deliverables

A. Project Kick-off Meeting Minutes.

B. Site Visit Summary.

C. Developed water model for the supply and distribution system.

D. Draft Report for review and comment by stakeholders and WIFA technical Personnel.

E. Final Report. A list of potential actions for each category will be developed. The potential savings for each measure will be calculated based on standard industry Best Practices. Implementation cost will be estimated. A lifecycle cost analysis will be performed on each potential measure to determine its priority in the decision matrix. Other factors such as siting concerns, equipment availability, maintenance and reliability will also be addressed in the decision matrix. Funding factors including utility rebates and availability of state/federal grants (typically for renewable resources) will be addressed in the decision matrix when appropriate.